

[Partial Translation]

DOCUMENT 1

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(Iwanami Dictionary of Physics and Chemistry)

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[omission]

- An item indicated by a handwritten reference number 1-1  
Dielectric Loss: A phenomenon in which energy is lost as heat when an AC electric field is added to a dielectric; or the amount of the lost energy. This is caused mainly by the dielectric after effect in which the electric polarization lags behind the change of the electric field, but may also be caused by the heterogeneity of the material. In general, the dielectric loss is indicated by the loss factor  $\tan \delta$  of the complex dielectric constant. The larger the loss factor is, the larger the heat loss is. In a ferro electric, a loss may be caused by hysteresis. The dielectric loss is especially important to high frequency. For example, a larger value of  $\tan \delta$  in a capacitor of a high-frequency circuit lowers the value of  $Q$  of a resonance circuit, and becomes a cause of heat generation. Conversely, the dielectric loss may be used to perform a high-frequency heating.

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- An item indicated by a handwritten reference number 1-2  
Complex Dielectric Constant: A ratio between the electric flux density  $D$  and the alternating electric field  $E$  expressed by complex

numbers in the case where the electric flux density  $D$  changes with a phase lag when the dielectric is multiplied by the alternating electric field  $E$

$$\epsilon = D/E = \epsilon' - i\epsilon'',$$

where  $\epsilon'$  and  $i\epsilon''$  are real numbers. When  $E$  and  $D$  are expressed as  $E = E_0 \exp i\omega t$  and  $D = D_0 \exp i(\omega t - \delta)$ ,

$$\epsilon' = (D_0/E_0) \cos \delta,$$

$$\epsilon'' = (D_0/E_0) \sin \delta,$$

where  $\omega$  represents the angular frequency, and  $\delta$  the loss angle. Here,  $\epsilon''/\epsilon' = \tan \delta$  is called loss factor. In the case of the solid dielectric, the loss factor approximately ranges from  $10^{-4}$  to  $10^{-1}$ . The loss factor also varies according to the frequency, and may become a noticeably large value in a narrow frequency band.

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